EPA April 9, 2022, Comments on the Draft Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway Upper Reach - submitted February 21, 2022

#	Section	Page	Comment
General - non-page specific comments			
1.	Data Evaluation Report or Data Report	none	In this data evaluation report, the data are appropriately presented and interpreted with a focus on design, and the report is clear, concise, and methodical. However, apart from preliminary identification of RAL exceedance areas and potentially applicable technologies, the report provides limited data evaluation, context or narrative explanation. As an example, the appendix compares surface and subsurface data in aggregate. What do the findings mean for site cleanup? Vertical data are now available, but the report does not discuss the data indicating elevated concentrations in some samples below the 45 cm or 60 cm RAL interval or -17 ft MLLW in the FNC. Are the data in all areas consistent with the conceptual site model? Do the data suggest any unexpected conditions (deeper dredging in the past, more or less sedimentation?) or mechanisms such as ongoing sources? What do we understand about the numbered preliminary RAL exceedance areas and how they relate to each other? EPA has highlighted some specific areas for additional text.
2.	IK percent threshold	none	Identification of preliminary RAL exceedance areas using indicator kriging and the 50% probability line is acceptable for purposes of this report, provided these are termed preliminary and EPA comments on this topic are fully addressed. EPA does not approve the 50% line as the basis for limiting remediation areas, however. Based on the discussion in the main report and Appendix K, it appears that LDWG acknowledges that the width of probability range bands shows uncertainty that generally should be addressed through additional data collection. LDWG will be preparing design documents at the 30% and 60% level without the benefit of the additional data. For this purpose, remediation areas developed for the 30% design should include all areas greater than 20% probability, which may include areas where the bands between 20 and 50% probability is relatively wide. This will help account for the possibility that additional data, when incorporated into the interpolation maps, will show that some or all of these areas do or are likely to require cleanup. Data collection should focus on narrowing these areas as much as possible so that we are minimizing the uncertainty associated with decisions. The larger the area we can classify as >50 % or <20%, the smaller our area of uncertainty. In general, characterization should aim to have gray areas that do not exceed the range of autocorrelation, as this represents the distance over which samples can properly be used for interpolation. Looking at the interpolation maps, most areas with probability contours wider than the range of autocorrelation are in areas with less sample coverage and likely rely on interpolation estimates with limited samples within the range of autocorrelation. Addressing EPA's comments on the cross-validation steps and maps, along with EPA recommendation about contour widths, will help LDWG identify and assess where there is more uncertainty in the interpolation. This may support a change in the probability thresholds for those areas.

			EPA notes that indicator kriging, which is focused on a binary (>RAL or ≤RAL), does not account for locations where the exceedance factor is particularly high. There are areas, such as in REA 19 and 20 (RM3.8), where isolated areas are shown requiring remediation, but where subsurface PCB samples have concentrations over 780 µg/kg dw. Given the range of concentrations in this relatively small area, EPA encourages careful thought about what conceptual model would lead to the conditions observed. As LDWG does the engineering, these areas should be included in a larger footprint for remediation. Consider this in other areas where RAL exceedances are particularly high.
3.	Replacing RAL exceedances with new data	none	The preliminary areas exceeding RALs have changed since the Phase 1 DER, mostly because of data collection in new locations. In a few locations, PDI sample results below RALs replaced earlier results exceeding RALs, and the areas preliminarily defined after Phase 1 have been reduced as a result. For transparency, identify the sample locations for which this is the case by using a different symbol on relevant maps and/or including a table that identifies the location and direction where LDWG used new data to replace earlier results. This is especially important to make visually clear in Appendix B, where cPAH concentrations are generally lower in recent sampling.
4.	Adjacent areas, EAAs.	none	Update and include attachment B of the PDI work plan, which included maps and surface data for the early action areas. It is important to have access to current info when designing nearby cleanup areas. This information should be updated as data become available and included in the design submittal, to provide an indication of EAA 'baseline' conditions prior to construction of the LDW remedy and to flag anomalous results that may indicate a source (upland or in-waterway). Similarly, add a section (or sections) to discuss adjacent habitat restoration, early actions, and upland cleanup areas; Norfolk EAA, where samples indicate significant recontamination; and the carbon pilot plots (where sampling results were mixed). Acknowledge that the upper reach design will include or address the interface with these areas, and briefly note how. Correct graphics that incorrectly show the carbon pilots as excluded from RAL exceedance areas.
5.	Context	none	The public may have questions about the EAAs and whether EAA boundaries and actions addressed the extent of contaminated sediments laterally and vertically. In addition, the public may ask about the adequacy of PDI characterization in LDW at and beyond the boundaries between EAAs. Add a section describing the lateral and vertical bounding of contaminated sediment adjacent to the EAAs, particularly how deep LDW sediment contamination may reasonably be expected, given pre-EAA data. Add a section of text relating the EAAs to the characterization done in PDI Phase 1 and 2 and prior existing data. Include some representative (conceptual) cross sections near EAAs. These should account for the 10-foot strip outside the channel lines where capping is not allowed and for the additional layback that may be necessary to ensure slope stability during maintenance or remedial dredging in the channel. Understanding these areas will help support design of cleanup work along the edges of Boeing Plant 2, Terminal 117, and Earle M Jorgensen EAAs. Consider whether there are data gaps to be filled in Phase 3.
6.	Purple box data	none	Purple box symbols representing prior core locations without RAL intervals are still on the maps. This makes it look like the data are being used in the interpolation or in the general understanding, but it is not clear that this is the

			case. If these are not relevant to our general understanding of contaminant distribution or a specific design, eliminate these symbols from the maps. If they are, make this clear.
7.	Benzyl Alcohol	none	Add a paragraph that cites LDWG's memo (Attachment A of the PDI workplan) regarding benzyl alcohol and briefly summarizes the memo (e.g. ubiquity, variability, toxicity etc.). For purpose of the upper reach only, EPA does not require consideration of benzyl alcohol exceedances in defining the remedial design footprint. (Note: EPA anticipates that LDWG will include benzyl alcohol analysis of sediment samples in the Middle Reach Phase 1 pre-design investigation work plan/QAPP and will provide the results to EPA in a data file and on a map.)
8.	Update base maps	none	The LDW shoreline on the west side has been modified by construction of the habitat restoration at the former T-117 site. Update base maps to include this. Additionally, where outfalls are shown, update maps to reflect the 2020 report prepared by Ecology.
9.	FNC	none	Add a section regarding the federal navigation channel. The ROD (FN23) allows postponement of remediation in areas where the only shoaled intervals exceeding the RALs are below 60 cm. Indicate whether there are any such areas in the upper reach (other than Area 11) and note whether the design is addressing all REAs, including REAs in this category. For transparency, discuss the availability of z-layer data (six locations the 30 cm interval > 12 mg/kg OC) and include a map of channel sample locations and COC concentrations. Ensure that the symbols used on maps (Map 3-4 and 3-5 series) distinguish between locations with 0-60 cm data and with shoaling interval data. In shoaled areas with no RAL exceedance above -17 ft and z-layer COC concentrations exceeding the 60 cm subtidal RAL for Recovery Category 1 areas, e.g. 208, 217, 222, 225, and 572, indicate how these areas will be addressed in remedial design or future actions. [The z-layer results are for the 30 cm interval that would be exposed by maintenance dredging. EPA recognizes that the z-layer data don't allow exact comparison to the 60 cm subtidal RALs.] Prepare and include conceptual cross sections that illustrate navigation channel/shallow subtidal shelf/intertidal/bank relationships, particularly adjacent to early action areas. The ROD prohibits capping in the nominal 10-foot buffer outside the maintenance channel area to avoid sloughing or cap damage related to maintenance dredging. The 30% design should demonstrate that remedial and/or maintenance dredging won't destabilize side slopes, including portions of the 10 ft buffer that may be contaminated below RAL intervals, and shoreward slopes as appropriate.
10.	Deeper interval data	none	Briefly acknowledge in the revised DER that there are locations where intervals below -17 ft MLLW in the FNC or below RAL intervals (e.g 60cm or 45cm) have elevated PCBs or other contaminants. Discuss FNC and non-FNC areas separately. In addition to including the additional core sample results in tables and maps, include a brief discussion of the FNC locations and text in the revised DER.
11.	Peri-RAL results	none	The report focuses on >RAL results, and though it shows results with EFs of 0.9 to 1.0, it is not clear how the remedial design intends to address such areas. The ROD requires active cleanup for sediments exceeding RAL, but the report

			should articulate whether and how the EFs above 0.9 will be considered in design decisions.
Main section maps *(note some comments may affect maps and text)*			
12.	Maps, general	none	Map footers (most) have a typo: Evalutation should be evaluation. The maps should include DER draft submittal date and "draft," in case the folio is separated from the DER or broken up. The -15 to -17 ft interval shading is very helpful for cores in the FNC, but it isn't necessarily relevant for slips and berthing areas. What has been done so far to determine berth depths, such as in and outside of Slip 6, and to show core results relative to these depths?
13.	Map 2-4 and 3-4 series (title on TOC)	none	Clarify in map titles that the 2-4 series maps are based on PDI data only and that the 3-4 series of maps are based on the design dataset (including pre-PDI results). If this can be done simply, make this clarification on all relevant map titles.
14.	Map 2-3 series	Pdf page 4	Explain why some intervals are noted as "z" and others that are in the same stratum and representative of the z-layer get another letter. Include the additional results received in late February. Add a note that locations where samples were collected but not analyzed are not shown. Where there are 10 cm interval data, or 45 or 60 cm data associated with the vertical samples (but from prior sampling), add a row for RAL exceedance. Indicate in core graphics which of the vertical samples are in areas with measured or presumed RAL exceedances. Include the dry weight and/or TOC normalized PCB concentration in the light purple boxes.
15.	Maps 2-4a-j	Pdf pages 6-14	Maps do not include additional results of archived core intervals. The results are now available as of late February. Update figures with the new results. For purple boxes, add note that indicates where the results can be found, and include the results - or don't include the purple boxes. Add note that locations where samples were collected but not analyzed are not shown, unlike Map 2-2a and 2-2b. Where conflicting vertical core results for one location are presented in the core results box, show both sample numbers on map, or reference in callout box text. Core 579 shows a strange gray shading, as does 621, 629, 579 and others. The legend doesn't explain. (Is that "color may vary"?). 579 has horizontal stripes, some have vertical stripes. 621 and 635 has improbable or undecipherable (two colors for native) conditions. Maybe for native material, hashing (as noted in legend) should actually be used? Please check, correct. Check that all results of samples collected outside the EMJ EAA are included. Two (PMU-1 and PMU-2 from the 2018 perimeter samples have callout boxes with exceedances in Map 3-4c). If excluded from the design database, state why in the document or on map.
16.	Map 2-4g	Pdf page 11	Why do Slip 6 vertical cores (673b and 674) have different alphabetical labeling? Are the intervals with B as the second letter related to Boeing? The core boxes show the -15 to -17 ft interval gray shading, which is critical for cores in the channel. Show these cores with the relevant depth for berthing. Core 673 went very deep. What was the reasoning behind that? From RM 4.1, the use of shading in the core box to differentiate transects isn't making sense. The note says W-E orientation, but the orientation of the shore is

			NW – SE. Are transects along shore or orthogonal to shore? Clarify, consider adding dotted line to indicate core transects. Extra core column can be removed between 673b and 674. All V cores need consistent core # label (numbered on map like 665 and others) even where callout box addresses RAL intervals. For example, 662 is hard to find, because it's in the callout box for LDW21-IT662 (2021). Slip 6 sampling shows many locations have results close to but below RALs. Consider this as the design proceeds. The dry weight PCBs maps (A-2b e.g.) show a surface sample with PCB concentrations above 130 ug/kg that is not included in the REAs, due to TOC normalization. Slip 6 is Boeing property and is getting shallower. Is Boeing considering dredging the slip for berthing reasons in coordination with cleanup? The public has expressed interest in understanding the change in REA compared to ROD Figure 18 in this area. Discussing this area in text may be helpful.
17.	Map 2-4i		RC 1 area near the "claw." Figure 6-5 of the FS shows this as a simple rectangle in this area, as a STM predicted high flow scour >10cm. Is the shape a graphics artifact? Consider whether this shape should be adjusted or an area of uncertainty around it added, based on geomorphic knowledge?
18.	Map 2-4i		Sample LDW-SS148 (2005) has a total PCB EF >1 (1.7), so the sample icon should be red.
19.	Map 2-5c, 2-6 b		The former T-117 shoreline is no longer accurate. Update base maps to reflect the (excellent new!) habitat created. Areas below MHHW are now part of the Lower Duwamish Waterway.
20.	Map 2-6a	Pdf page 19	In the legend, use a more descriptive label for "cable area". Maybe add "buried" or "subsurface." Do we know the approximate depth they are buried? Note where the cables are and whether the area shown includes a buffer, if so. Is the area a ROW or a Coast Guard RNA? Notes box: Spell out FCA. Change bridge hatching to make it distinct (or use a solid bridge color under the cable hatching). For bridges, add elevation of bottom (relative to MHHW if that makes sense), as the plan/aerial view isn't descriptive.
21.	Map 2-6e, f		Label Hamm Creek. Timber groins: what is their function? What changes to the bank have happened adjacent to the Boeing Employees Activity Center? Describe them in boxes (not "Shoreline work has occurred" only).
22.	Map 2-7		The property labels are too small. Please enlarge.
23.	Map 2-8 and report		Areas of the channel that are not routinely dredged were surveyed by USACE in recent months. Add text to the report noting how these data sets compare and if they are consistent with 2019 maps and anticipated areas of sedimentation. Consider including the comparison "increase/decrease" map comparing 2007 and 2019 (and/or more recent data).
24.	Map 2-10		"Sediment thickness measurement transect areas" – Clearer title needed, such as "Areas where sediment thickness over riprap was measured". Add note to reference the more detailed section.
25.	Map 3-1		The color distinction between no data and less than 50% change is difficult to discern. Change the colors of less than 50% change (it is difficult to distinguish from No Data). Add identifiers of location (e.g. show RM 3.9, identify upland property and carbon pilot study). Clarify that these are samples of the 0-10 cm

			depth interval. Add note to legend or change title to make it clear there are other samples in this area that are not shown, as they were not reoccupied. Use elevation contour lines. The bright color bands, odd boundaries and color gradations are distracting. It might support the discussion of physical changes if the bands indicated CHANGES in elevation. If material is being added, it is more credible to consider it RC2. If it is not accreting, is eroding, or is likely to erode under future weather scenarios, RC1 is a better fit.
26.	Map 3-5a, b		The green for ENR is difficult to distinguish from the orange of dredging, especially at small locations like 7, 10, 23, 25, 33. Please change to a stronger shade of green. Expand the size of the notes, as they are important. The EAA designations should be pointing to the gray sediment areas. Upland sites should be identified. Add language to note a to explain that final areas and technologies will be refined during RD, subject to EPA approval, as are adjacent areas with different applicable technologies, multiple applicable technologies in one area (29, for example), or uncertainties in the RAL exceedance areas as currently defined, and area-specific technologies. Add text to note **a** to make readers aware of appendix B. Add label to identify adjacent property(ies). LDWG and EPA need to discuss options and articulate a path forward for the carbon study pilot areas. Add a note to indicate that these areas are included in the upper reach for purposes of remedial design.
27.	Map 4-1		In text and in graphic, note that the RAL for recovery category 1 and 2/3 are different (2Xbenthic SCO in RC2/3 areas). The area where USACE routinely dredges should be marked as such, as it otherwise looks like a data void. The area between REAs 12 and 14 shows fewer surface sample points than many other areas, because the sampling focused on the 60 cm interval. Comparing this to Map 2-2a, it looks sparse, perhaps because dot size is smaller. Confirm that the same samples are shown on both maps and consider a different symbol on Map 4-1.
Main Body of Report *(note some comments may affect text and maps)*			
28.	1.0 Intro	pdf 9	'The DER presents the combined results of the Phase I and Phase II Pre-Design Investigation (PDI),' – The Phase 1 and 2 report references but does not summarize some of the Phase 1 reporting. Qualify the introduction and identify in a table or list specific Phase 1 elements that are not presented in this report.
29.	Table 1-1 Areas to be defined	pdf 11	For RAL exceedance area column, please reference Appendix K and relevant map after "DER (this document)" in "where defined"
30.	1.2 DQOs	pdf 11	Use a more definitive term than "addressed" when discussing the DQOs. Were the objectives met or partially met?

31.	1.2	pdf 11	State in the text that the compiled dataset (Phase 1, 2, and pre-PDI data) is or will be posted on the LDWG web page. It will be helpful to Ecology in evaluating source control sufficiency and for reviewers of design deliverables. In addition, EPA requests that LDWG compile and post EAA monitoring data in native format. (This will need periodic updates as monitoring data from subsequent years are added). The monitoring data is not consistently added to EIM, but LDWG parties have access to all of the data being generated. It will help during design to have access to data in areas adjacent to LDW REAs or SMUs.
32.	Table 1-3	pdf 13	DQO14 - clarify whether groundwater velocities data have been collected or not during Phase II PDI. If not, then add a note below the table. Is this a Phase III data gap?
33.	Table 1-3 and Section 4.1	pdf 13	DQO 9 Activities Conducted to Address DQO: 2.1.3 doesn't exist in this DER. Should this be 4.1? "Under-structure sampling" is the term used in Section 4.1. Please use consistent terminology or include clear cross-references. The statement that "contamination **does not extend** under any of the over-water structures…" needs to be supported, as it assumes that samples from areas outside a structure's footprint can be used to infer conditions under the structure. In Section 4.1 provide context about the current and past use of the structures and what field observations might inform the conclusion that this area would not be contaminated.
34. J	2.1.1.3 Counts	pdf 18	Notes 3 and 5 of Table 2-1 say that no shoaling material was present at one Phase I location (217) and two Phase II locations (548 and 549). However, 548 and 549 are presented in Map 2-4b as partially located within the shoaling area, and Map 2-4d shows that 217 is entirely located within the shoaling area. Discuss the magnitude and potential reasons for the difference and consider whether the footprint of the shoaling areas on the maps should be adjusted based on observations in the field. The Corps of Engineers completed a waterway-wide hydrographic survey in recent months. Compare these surveys for further information on whether there are temporal changes consistent with the CSM or inconsistent with it, uncertainties in measurement, or something else.
35.	Table 2-2	pdf 21	Bottom Row, surface samples: PDI Dataset Total>Total Archived (n=73) is not the sum of phase I and II entries. Check sums and correct table or explain the nuances with more notes.
36.	2.1.2.1 Chemical Analytical Methods	pdf 22	"The Tier 2 analyses included selected analytes that exceeded RALs in nearby Tier 1 samples or were analyzed for additional spatial coverage." Revise text to identify a max distance for what "nearby" means in this sentence. State the reasoning for not considering this a data gap for defining RAL exceedance areas (Can be a reference to a descriptive section of another design document, etc.)
37.	Table 2-4	pdf 25	Include an appendix table listing individual COCs (not just as groups such as Other Metals, Other SVOCs, etc.)
38.	2.4.1, Map series 2-6	pdf 38/39	Incorporate Ecology's 2020 outfall inventory update, and show outfalls on all maps if possible, but at a minimum on maps 2-6a through 2-6f, to aid in reviews of source control sufficiency.

			If LDWG has data for 0-2 cm samples excluded from the design data set, discuss with EPA and Ecology.
39.	2.6.2 Sed thickness over armored banks	pdf 44	Briefly describe the probing and note how the prober could distinguish between compacted sand and other materials. Confirm that the debris observations made in this effort are combined and are not in conflict with the debris observations in Appendix G.
40.	3.1 Data mgt rules	pdf 46	'The LDW database includes all sediment data that have been collected for the LDW.' Provide more information on this (describe how it was developed)? EPA and Ecology request a copy of the current database for use in source control sufficiency review. Understanding that it is updated regularly, consider keeping a current version available on the LDWG web page.
41.	3.1	pdf 46	Data management rules: Second bullet mentions excluding data from an area that has been dredged post sampling. For such an area, we want to include data if there are post-dredging sample results (subject to excluding areas within EAAs). Is that happening? Have any upper reach areas been dredged in recent history? Excluding data that was collected as part of a monitoring program and has superseded by newer data (e.g., data from monitoring year 1 are superseded by those from monitoring year 2) may be okay, but it may not be possible to confirm that such changes are temporal rather than an indication of spatial or other variability. Outside EAA footprints, are there any cases that fit this exclusion? Discuss. Excluding data from composites: Verify that this does not eliminate USACE core samples, which, though made of more than one core, are intended to reflect conditions at a point location. The Phase 3 sampling will address this conflict.
42.	Table 3-1	pdf 47	Note 1: discrete, not discreet. State source(s) of the 18 shoal interval sample data post-FS.
43.	Table 3-2	pdf 48/49	Note 2 says "Shoal interval samples consisted of shoaled material from the FNC (i.e., sediment above -15 ft MLLW in this reach of the LDW) and sediment from the -15 to -17-ft interval (see Map 2-3)." No change is needed to the DER to address this comment, but EPA notes that the US Army Corps of Engineers could include in maintenance dredging contracts areas with material above -17 ft MLLW but below -15 ft MLLW.
44.	Table 3-2	pdf 48	Add a column to present the % of RAL exceedance for the combed four columns.
45.	Table 3-2	pdf 48	Consider breaking up the totals by data source, similar to previous Table 3-1. Confirm that all the RAL-exceeding COCs are presented here.
46.	3.2 Comparison of Design Dataset with RALs	pdf 49	The last bullet indicates that there were three samples with PCB RAL exceedances in the shoaling samples. That is inconsistent with Table 3-2 which shows there were four samples with RAL exceedances.
47.	3.2	pdf 49	Following "one pre-PDI surface sediment sample had a concentration exceeding the ESD RAL" add, "in a location where one or more other COCs exceeded their respective RALs."

48.	3.3.1 Methodology	pdf 50	Bullet at bottom says: "Areas with all contaminant concentrations increasing (red) are considered for adjustment to Recovery Category 1." Correct this to be consistent with Table 23 of the ROD: the chemical criterion for RC1 is "increasing PCBs **or** increasing concentrations of other detected COCs that exceed the SCOs (> 50% increase)." Table 23 of the ROD notes that both surface data and cores should be considered. Add discussion about how this was addressed.
49.	3.3.2, Table 3-3	pdf 51	The recovery category for area reviewed was discussed at a meeting with LDWG, but a final determination was not made. While the results are mixed in this area, EPA believes it may warrant changing to RC1 given the magnitude of the change in PCB levels at one of three sample locations at the north end. The sample lies within RAL exceedance area #24. According to Appendix K, the remedial technology assigned for this area is dredging and backfill, in part because this PCB contamination at this location is "vertically bounded". However, because Appendix K does not indicate the depth of or basis for this vertical bounding (see comment #6 below), we can't determine whether PCB contamination will be removed down 2.5 feet (including interval B – 136 ppm OC) or 3.5 feet (including interval C – 30 ppm OC). It seems that the final recovery category for this location may influence the depth of remediation applied to this area. The data presented is for surface samples only. Is there any core information that could be considered? Briefly discuss the other lines of evidence and how they were considered, such as physical observations and changes in bathymetry. Given the history of contamination in this area and the potential for wave action or other surface disturbances, EPA suggests that additional data be used to support RC2/3 categorization or that the design consider this area RC1.
50.	3.4 Areas with RAL exceedances and preliminary tech assignmt	pdf 52	The sediment core data collected during PDI work as well as the data presented in the Jorgensen EE/CA report indicates the presence of PCB contamination as deep as 24-25 feet below MLLW within certain areas of the navigation channel (e.g. sampling location of 549, Map 3-4b). Remedial action may not be required to address the deep contamination in these areas according to the ROD, but the report should at least note the presence of the contamination at depth. Add a summary of the FS basis for concluding that below 60 cm, contamination is not likely to be exposed. As a verification step, EPA requests that a breakthrough analysis (screening or comprehensive) be performed prior to the 30% design submittal for areas with known subsurface contamination above RALs that may not be removed. If breakthrough is possible, particularly in the federal navigation channel (e.g. vertical core 554) and Recovery Category 1 areas outside the channel, EPA encourages LDWG to consider removing the material entirely. The alternative may risk having to return to address this situation later.
51.	3.4	pdf 52	Are the preliminary technology assignments developed using the RAL exceedances from design dataset or just the PDI dataset? State this clearly in the text.
52.	3.4.1.1 Interpolati	pdf 52	Explain the 88% metric in more detail. Appendix K indicates the number is 85%, but what does this mean from an analytical standpoint if in section 3.2 PCBs

	on Methods		were exceeding RALs in ~11% of the design dataset samples. Does the 88% vary by interpolation method used?
53.	3.4.1.1	pdf 52/53	Add paragraphs to explain the other interpolation methods NOT used (ordinary kriging, IDW) and their merits/demerits compared to the two methods selected.
54.	3.4.1.2 Interpolation Results and Uncertainty Analysis	pdf 53/54	'These lines of evidence, which are further discussed in Appendix K, show that the interpolations are unbiased and more precise in areas of more dense sample coverage, and that spatial correlations among neighboring samples help to control variance and uncertainty in the interpolated values.' Identify areas where less dense sample coverage and resulting uncertainty may warrant Phase 3 sampling.
55.	3.4.1.2	pdf 53/54	Text reads: The indicator kriging contours represent the probabilities of exceeding the applicable RALs, expressed in units of percent. The 50% probability of exceedance contour represents the median, central tendency, *and best estimate* of the horizontal RAL exceedance boundary (Anchor QEA and Tetra Tech 2016; Thornburg et al. 2005). Delete "best estimate." We recommend you replace the subjective term with the explanation of balanced error rates presented on page 46, paragraph 3. This is an objective way of highlighting the benefits of the 50% probability contour. Revise section 3.4.1.2 to include a brief discussion of the specific methods that will be used to identify areas of uncertainty (which may then be addressed through the engineering of the cleanup footprint and/or by identifying the need for additional (Phase III) data).
56.	3.4.2 Preliminary Remedial Technology Assignm'ts	pdf 55	"…although some areas still have more than one technology option that may be applied…" "…some areas may have subareas with different technology assignments." In this instance, EPA approval is required. EPA encourages LDWG to use the more permanent remedy among the options, and to avoid containment where possible, to minimize the need for intensive monitoring or ICs. FN 11 - Habitat areas were defined in the FS as all areas above -10 ft MLLW. The ROD indicates that such areas will be refined during Remedial Design. The elevation-based definition is sufficient for now, but EPA notes that the definition may be refined as the design progresses. [no change to document required].
57.	3.4.2 and Map3-5a	pdf 55	Map 3-5 series shows preliminary technology assignments. As stated in Table L-1 and on Page L-5 of Appendix L, dredging will be applied to the portions of Area 3 located within FNC, and no cap will be needed since the vertical extent of RAL exceedance has been bounded around -21 MLLW. Correct Map 3-5a to reflect full removal of contaminated sediments in this area. Confirm that other areas or portions of areas within the FNC shown as partial dredge and cap are correct. If any areas can be fully removed, EPA recommends that LDWG consider the benefits of avoiding institutional controls and long-term monitoring required in capping areas.
58.	3.4.2 and Map3-5b	pdf 55	The Phase I bank investigation video (E-5.0-4.8RM) shows some erosion in Areas 32, 33, 34 and 35. Consider dredging or excavation in these areas, even where the ROD allows containment (#33 for example. Color is hard to distinguish in some cases). Also several aged piling wing walls are present.

			Suggest removing them if they are not functioning and their presence poses access issues for selecting more permanent remedial alternatives.
59.	4 Initial Identification of Phase III Data Gaps	pdf 56	"the only structure in question in the upper reach was the pier in Slip 6. Phase II sampling showed that the contamination did not extend to the edge of this structure. Thus, no additional under-structure sampling is needed." Contamination is present in Slip 6 samples, even if not above RALs. As noted in an earlier comment, "didn't extend" assumes there would be continuous contamination above RALs. That may not be the case. Summarize additional data or operational information to support the conclusion.
60.	4.1 Further horizontal delineation (DQOs 9 and 10) and Map 3-4a	pdf 56	First bullet point: the example provided (west of locations 705 and 706 [Map 3-4a]). It is difficult to find these locations on the map. Add descriptive information, such as "within Norfolk EAA boundary" Since the information is available, please list all areas that need RAL exceedance area bounding. This can be in a table.
61.	4.1	pdf 56	Is "RM 3.19 W of the FNC [Map 3-4a])" an example of an area that fits the description? If so, add "(e.g." to fix this typo.
62.	4.1	pdf 56	Text indicates that a data gap to be addressed in Phase III includes investigating locations with greater uncertainty in the data interpolation and references the uncertainty analysis in Appendix K. Appendix K doesn't discuss locations with greater uncertainty. Revise appendix K and discuss briefly in main text. (See also comment on 3.4.1.2)
63.	4.1	pdf 57	'23 are either within RAL exceedance areas or immediately adjacent to such areas. These locations will be addressed in 30% design.' The use of "addressed" is unclear. State that these areas will be incorporated into remedial areas. MNR to SCO "The remaining eight *surface sample* locations are not within or immediately adjacent to a RAL exceedance area; they are summarized in Table 4-1." Clarify by adding "surface sample" before locations, as shown.
64.	Table 4-1	pdf 57	Clarify title to indicate that these are surface (0-10cm) samples. Regarding LDWSS384, there are 2 yellow surface sediment samples in this area (West side of turning basin) on Map 4-1. Is there a sample missing from this table? The 2XSCO RAL in RC2 areas of the FNC is in the ROD. One sample is below the RAL but exceeds the SCO (for mercury, by a factor of 1.1) in the FNC. However, if the Corps plans maintenance dredging this may be an issue. Consider getting additional data in Phase 3 or addressing these sediments with active remediation.
65.	4.2 Further vertical delineation (DQO 12)	pdf 58	'…shoaling cores collected by USACE in 2012 (LDW13, LDW14, LDW17).' Reference the map that shows these core locations (or add to map, then reference).
66.	4.3 Other engineering data (DQO 14)	pdf 58	Is additional title information needed? (cable ROWs, for example). Any ARARs related info needs? Any potential habitat improvements possible? SPU Hamm, utility ROW on East side, removal of unnecessary structures? Also: groundwater issues anywhere? source confirmation?

			"Based on the chemistry results in the design dataset, dredged material treatment studies are not anticipated to be necessary." Please expand on this topic. Will sediments need to be dewatered?
67.	4.3.2 Debris	pdf 59	The appendix regarding topographic survey results describes debris observations briefly but doesn't include a map that shows what debris is where. This should also show debris noted in the bathymetric survey maps. (Text says: … identification of large surface debris below the MLLW elevation is not considered a data gap).
68.	5. Next Steps, FN12	pdf 60	"After the Phase III QAPP Addendum is approved by EPA, LDWG will conduct the Phase III PDI. Phase III PDI data collection is planned for November 2022." Results will be used in RD and included in 90% design. Footnote 12 explains that Phase III results won't be available to support a DER on the workplan schedule and will not be available prior to the 60% design submittal. Discuss when preliminary results and/or the **data report** will be in hand and provided to EPA. Specify additional deliverables – maps, for example – that will be provided to EPA prior to the 90% design to ensure that there are no surprises at that stage of design. For discussion at LDWG meeting: Consider moving time critical data collection activities up. Discuss what key data (chemical or physical or geotechnical or other) can be gathered in a separate more accelerated field effort. FN 12 "The PDI work plan stated that if Phase III design sampling is conducted, a Phase III DER will be submitted to EPA 45 days after submittal of all Phase III data. Because the validated Phase III data will not be available until mid-March 2023 at the earliest, they will not be available for 60% design, which will be submitted in February 2023, and comments on a Phase III DER (if one were prepared) would not be available prior to 90% design, which will be submitted in June 2023. Therefore, the Phase III DER elements describing the results of and deviations from the Phase III PDI will be appended to the 90% design, and a separate Phase III DER will not be submitted."
Appendix A - Maps with Dry Weight Concentrations of COCs and PDI Sample Coordinates and Elevations			
69.	Map A-2 Series		Add note to legend to explain the basis for the different dots/concentration ranges.
Appendix B – cPAH data and RAL exceedances relative to 2014 ROD (received mid-March)			
70.	Appendix B general		The September 2021 map based on Phase 2 preliminary data showed an area of cPAH 'additional exceedance area' in Slip 6. Is there new data that supersedes the old, to the point where no work is planned? This needs to be made clear to the public.
Appendix C – Relationship between surface and subsurface COC concentrations			
71.	Appendix C general		For the 60 cm interval, this shows higher concentrations in subsurface samples than surface samples (for PCBs and PAHs), indicating that we cannot reliably consider surface sediment indicative of subsurface concentrations of PCBs and cPAHs. Please review the dataset for locations where we have 0-10 cm data, either from existing data or analyzed during the PDI, that is below RALs and no corresponding subsurface data. In these areas, address in the body of the report whether there are data gaps for subsurface intervals or if there is sufficient subsurface information. Based on these results, future sampling

			should always include surface and subsurface samples at a given locations. If tiering is desired, it would make sense to analyze the 0-10 as Tier 2, only if 0-60 is clean. Add a row to Table 3-3 with RALs for surface sediment.
72.	Appendix C graphics		Add text or graphical information relating samples to the RALs to provide an idea of the relevance of the surface/subsurface difference. Perhaps different dot colors or an additional comparison that employs multipliers of the surface RAL (12 mg/kg OC). Does it affect the conceptual site model? Where COCs are below the most stringent RAL in both surface and subsurface results, how important is the correlation? The reason we might expect to see lower surface than subsurface concentrations is presumably source control and deposition/mixing of cleaner sediment at the surface (natural recovery), especially in RC2 areas. If data are separated by recovery category, is there a difference in the relationships between surface and subsurface contaminant concentrations? Assess this and modify the appendix accordingly if so.
73.	Appendix C		Some of the graphics seem to show different patterns in different areas (see River Mile intertidal PCBs). Are the differences statistically significant?
74.	C-2		It could be clearer what this signifies. Is it the difference between paired surface/subsurface concentrations and how that difference varies?
75.	C-4		There's a bar off to the right on the dioxin graphic: which sample has 300 ug/kg TEQ d/f more in 0-45 cm than the surface sample?
76.	Section 4		Reference should be to final, not proposed, ESD.
Appendix E - Bank Inspection Results			
77.	Tables E-1a and b		Is Appendix E info additional to Ph 1 DER info? Is there additional info on CD/DVD? "Not observed" – Does it mean access was not provided, that no observations were made for some reason, or that the condition in question (erosion, for example) was not observation (that would/should be N in the column). Add a note explaining this text.
Appendix F – Structures inspection results			
78.	General		There are some structures with poor or even serious rating. How is this information being considered? Phase I-only information may not be relevant to the design given the RAL exceedance areas so far. Where structures are in poor condition, however, areas that are not currently of concern as sources could become more of an issue for source control or cleanup (failing piling arrays, e.g.). Phase 2 structural information and its relevance to the cleanup should be more clearly tied to the updated RAL exceedance areas. Provide more discussion. Are there areas where dredging or partial dredging and capping is called for that could impact structures? Are there data gaps to fill in Phase 3?
79.	Table F-1a		The structures summary table includes a number of N/A. Might be helpful to have a numbered note and an explanation (not just spelled out term) of why N/A is used. If the condition of the Phase 1 only structures is not likely to be relevant, these rows could be grayed out, also.
80.	Table F-1b		The outfall summary table includes a number of entries where the active/inactive status is listed as unknown or N/A or conditions are noted as

			TBD. Ecology may have updates to this information from 2020. Incorporate this new information and reference it. TBD needs a table note to explain why it is TBD and how will this be refined (will more information be obtained?)
81.	App F	pdf 6	"the FCA reports for structures include a material conditions rating" – Either summarize the findings of the material conditions assessment or explain why that isn't necessary/relevant.
Appendix G – Topographic Survey and Bank			
82.	Attach't G-2		For bank features presented in G 1-2 in Appendix G, include geographic coordinates (or RM range and E/W of river) for each field record.
83.	App G Maps		Show River Mile and include inset of G 1-1 map showing topo survey locations. The areas are otherwise difficult to locate spatially. The legend shows "proposed topographic survey area, but actuals should be shown. Delete proposed, if so. It is not clear that any of the features or findings, such as areas with debris, are identified on the maps. This would be good to have graphically, not just as notes in the field forms. Discuss whether the source of the debris may be relevant: could some of the concrete have come from areas where caulk joints contained PCBs? Discuss how this can be assessed. Map G1-7 shows an explosive storage area next to the bank. Is this facility in current use? Does Boeing typically include such information in public documents? Consider whether deletion is appropriate. If retained, add a note to the map to clarify its use and indicating where additional public information can be found (such as a community contingency plan).
84.	General		State how this data may be used in remedial design. Does it mean the design will address removal of overlying sediments, for example, or require extra caution during dredging to avoid damage to equipment or structural impacts? Discuss how it is known whether rip rap is overlying contaminated material. In such cases, how will areas like this be handled?
85.	App G	pdf2	"(not considering landside inspection that may be conducted)" – Discuss further. Is this a Phase 3 data need?
Appendix K – Interpolation Methods and results			
86.	Section 5.1	K-17	Text reads: "Where indicator probability contours are tightly compressed, there is more certainty in the location of the RAL exceedance area boundary. Where the probability contours diverge and separate, there is more uncertainty in the RAL exceedance area boundary." Please give example of each from Map K-3c to illustrate this concept.
87.	1.0	K-1	Third paragraph, second sentence: Replace Syracuse Research Corporation (former name of company) with the company's name SRC, Inc.
88.	1.2	K-4	Footnote 3, please provide reference where the specific organic carbon (OC) normalization range is decided.
89.	1.4	K-7	Please provide further details and logic on how the river segments were chosen. Specifically explain what you mean by "refining the correlation structure."
90.	2.4	K-7	Second paragraph, provide a further explanation as to how OC-normalized data combined with the dry weight measurements outside of the OC-normalization range does or does not affect the distributional parameters of the dataset
91.	2.4	K-7	The second sentence of the second paragraph should be revised to clarify that the ordinary kriging method does not rely on an assumption of normality to compute the kriging estimate. The kriging estimates are calculated using

			weighted least squares, which makes no distributional assumptions. Some methods for assessing uncertainty in the kriging estimates assume normality, and data are often transformed to facilitate estimation of the variogram; however, the ordinary kriging estimator is not derived from an assumed probability distribution model.
92.	2.4	K-7	The third sentence of the second paragraph should be revised to clarify that indicator kriging is not probability kriging. Probability kriging is a type of co-kriging that includes an indicator variable and the sample data.
93.	2.4	K-7 and K-8	Third bullet, second sentence is unclear and requires more details explaining the concept of how dry-weight exceedances "must be expressed on an equivalent OC-normalized concentration with the same exceedance ratio" and how this is different when using indicator kriging.
94.	3.1	K-8	First paragraph, second sentence implies that 0 represented exceedance and 1 represented non-exceedance, which is contrary to other citations (Section 2.4 second paragraph) within the document. Please reverse the numbers in the parenthesis to be "(1 and 0)" to be consistent or change other citations in the document to reflect how the data was actually coded.
95.	3.1	K-11	The sentence that begins with 'The nugget variance….' should state the nugget values were determined by professional judgment (rather than estimated using by weighted least squares).
96.	3.2	K-13	For Figure K-3, please describe its relevance to the interpolation results should be clearly provided, e.g., how does the figure and text help to interpret the interpolation results?
97.	3.2	K-13	Section 3.2 should provide the rationale for the search parameters used, including the use of a quadrant search, the number of points (per quadrant) and the search radius. Section 3.2 should also discuss the effect (in general) of the search parameters on the interpolated surface. For example, increasing the search radius and/or the number of points used in interpolation produces a smoother interpolated surface, with the predicted values having less variance.
98.	4	K-14	Second paragraph, second sentence. Citing one's own reports for justification that the 50% probability contour represents the best estimate of the horizontal RAL exceedance is not sufficient. Are there other references or technical publications that support this statement?
99.	4	K-14	Second paragraph, the combined maps of horizontal contamination are based on the 50% probability contour which has yet to be accepted as the appropriate delineation of contamination and is still under discussion with the EPA.
100.	4	K-14 – K-16	The report should describe how the uncertainty in the combined surface and subsurface PCB RAL exceedance boundary will be assessed. The draft report describes how uncertainty in the interpolations for the surface and subsurface could be assessed separately but does not address how the uncertainty in the horizontal boundary of the overlay will be assessed.
101.	5.1	K-16	The revised report should describe the method that will be used to assess uncertainty in "gray areas" by evaluating the combine widths of the 20-40% contours. EPA would recommend comparing the contour widths to the range of autocorrelation for the semivariogram that is driving that particular probability designations (i.e. surface or subsurface).
102.	5.1	K-16	See comments 15 and 16. The 50% probability of exceedance has not been accepted as the initial basis for the RD. This is still under discussion.
103.	5.2	K-17 – K-18	Consider moving cross-validation (Section 5.2) to Section 4.0. Cross validation is best used to compare the performance of different interpolation approaches

			(i.e., comparing cross-validation errors produced by different variogram models, search radii, minimum/maximum numbers of neighbors, etc.) (e.g., Isaaks and Srivastava, 1989; Goovaerts, 1997).
104.	5.2	K-17 – K-18	Whether it is retained in Section 5 or moved to Section 4, the cross-validation section should begin with a couple of sentences that describes how cross-validation is typically used (i.e., to compare two or more kriging approaches), as well as the limitation of cross-validation (e.g., Isaaks and Srivastava, 1989; Goovaerts, 1997). Furthermore, the evaluation of cross-validation errors should be primarily spatial (i.e., using maps of the cross-validation errors that overlay the sample data to show where the over- and under-prediction occurs).
105.	5.2	K-18	Maps of the cross-validation errors data should be included in the report. The maps should also include the sample data. These maps will show where the over- and under-prediction occurs. To improve interpretation of the cross-validation results, consider using plus and minus symbols to depict over and under-prediction errors, respectively, rather than (or in addition to) presenting actual error values. The size of the symbols should be proportional to the magnitude of the error.
106.	5.2	K-18	This section should also include maps that show the spatial distribution of classification errors, based on the cross-validation results. The classification error map should be overlain on map K-3 series which shows the sample locations along with the p20-P80 contours. These maps would show two types of classification errors: (1) false negative errors, sample locations where the interpolation results with a RAL exceedance removed result in an estimate that changes the probability classification of the grid cell to a lower probability; and (2) false positive errors such that locations where the interpolation results with a non-RAL exceedance remove changes the probability classification of the grid cell to a higher probability classification. The classification maps should be prepared for each of the probability values between 0.5 and 0.2. Tables that summarize the classification errors for each of the probability levels should be included in the report. The tables should include the number of false positives and false negatives.
107.	5.2	K-18	The third paragraph of Section 5.2 should include two separate evaluations of the contributions of the over- and under-prediction on the cross-validation root mean squared error (RMSE).
108.	5.2	K-18	The second sentence of the last paragraph in Section 5.2 should be revised to explain how the removal of one sample value doubles the distance between the remaining sample locations. The last sentence of the last paragraph in Section 5.2 should explain what variable or parameter is being overestimated by the cross-validation error statistics.
109.	5.3	K-18 – K-19	The report should provide a rationale for comparing the maximum kriging standard error (KSE) with the cross-validation errors. If the authors wish to compare individual or maximum KSEs to another sample statistic, we suggest using the variogram sill or sample variance. The rationale for comparing the KSEs to the variogram model sill is as follows: If the data exhibit zero spatial autocorrelation, the kriging error at each point of the interpolated surface would equal the sill (which is an estimate of the population variance). Therefore, comparing the maximum KSEs to the sill of the variogram model could be used to support the last sentence of the fourth paragraph. Also, please explain how KSE does not consider local sample variance.

110.	Attachmt K1	K1-2	The probability plots do not clearly show how the dry weight concentrations (outside the OC normalization range) compare to the OC-normalized PCB concentrations. Address this in revision. Color coding is suggested.
111.	App K Maps		Include symbology that indicate RAL EF on the Kriging probability maps.
112.	Maps K-4a-d	Pdf pages 9-12	Add RAL exceedance area numbers to this map.
Appendix L – updated remedial technology assignments			
113.	Table L-1	L-2	The inclusion of multiple technology assignments in the column needs qualification/explanation in the text, a table note, and inclusion of "or" rather than a comma (or other clear language).
114.	Table L-1	L-2	The preliminary tech assignment listed in the table for RAL exceedance area 3 does not match what is shown in Map 3-5a. Check and correct.
115.	Area-specific tech assignment explanations	L-4	Where applicable, please indicate the specific vertical extent core that serves as the basis for vertical bounding of contamination discussed for <u>each</u> exceedance area. For example, the 5th bullet for Area 2 would be modified to state "*No; RAL exceedances are bounded at -21.2 ft MLLW (Core #509) in Area 2.*" Doing this will help the reader to understand how the bounded depth was estimated.

References for comments on Appendix K:

Goovaerts, 1997. Geostatistics for Natural Resources Evaluation. Oxford University Press. New York.

Isaaks and Srivastava, 1989. An Introduction to Applied Geostatistics. Oxford University Press. New York.